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Solubility Product (K_{sp}), Significance of Solubility Product, Solubility Product Constant, Question (For CBSE, ICSE, IAS, NET, NRA 2022)

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What is Solubility Product, K_{sp}

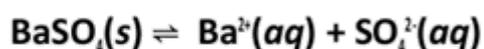
- The solubility product constant is the equilibrium constant for the dissolution of a solid substance into an aqueous solution. It is denoted by the symbol K_{sp} .
- The solubility product is a kind of equilibrium constant and its value depends on temperature. K_{sp} usually increases with an increase in temperature due to increased solubility.
- Solubility is defined as a **property of a substance called solute to get dissolved in a solvent in order to form a solution**. The solubility of ionic compounds (which disassociate to form cations and anions) in water varies to a great deal. Some compounds are highly soluble and may even absorb moisture from the atmosphere whereas others are highly insoluble.

Significance of Solubility Product

Solubility depends on a number of parameters amongst which lattice enthalpy of salt and solvation enthalpy of ions in the solution are of most importance.

Solubility product constant (K_{sp})

Most salts dissociate into ions when they dissolve.
For example:



This equilibrium system may be described by the mass-action expression

$$K_{sp} = [\text{Ba}^{2+}][\text{SO}_4^{2-}]$$

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- When a salt is dissolved in a solvent the strong forces of attraction of solute (lattice enthalpy of its ions) must be overcome by the interactions between ions and the solvent.
- The solvation enthalpy of ions is always negative which means that energy is released during this process.
- The nature of the solvent determines the amount of energy released during solvation that is solvation enthalpy.
- Non-polar solvents have a small value of solvation enthalpy, meaning that this energy is not sufficient to overcome the lattice enthalpy.
- So, the salts are not dissolved in non-polar solvents. Hence for salt to be dissolved in a solvent, its solvation enthalpy should be greater than its lattice enthalpy.
- Solubility depends on temperature and it is different for every salt.

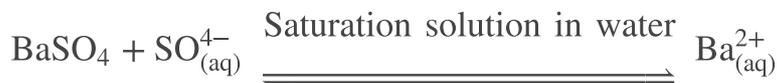
Salts are classified on the basis of their solubility in the following table.

Category I	Soluble	Solubility > 0.1 M
Category II	Slightly Soluble	0.01 M < Solubility < 0.1 M
Category III	Sparingly Soluble	Solubility < 0.1 M

Salts Are Classified on the Basis of Their Solubility in the Following Table

Solubility Product Constant

Suppose barium sulphate along with its saturated aqueous solution is taken. The following equation represents the equilibrium set up between the undissolved solids and ions:



The equilibrium constant in the above case is:

$$K = \frac{[\text{Ba}^{2+}] [\text{SO}^{4-}]}{[\text{BaSO}_4]}$$

In case of pure solid substances, the concentration remains constant and so we can say:

$$\begin{aligned} K_{\text{sp}} &= K [\text{BaSO}_4] \\ &= [\text{Ba}^{2+}] [\text{SO}^{4-}] \end{aligned}$$

Here K_{sp} is known as the solubility product constant. This further tells us that solid barium sulphate when in equilibrium with its saturated solution, the product of concentrations of ions of both barium and sulphate is equal to the solubility product constant.

Question

What is Solubility and Solubility Product?

Answer:

Solubility is defined as the maximum amount of solute that can be dissolved in a solvent at equilibrium. The solubility product constant (K_{sp}) describes the equilibrium between a solid and its constituent ions in a solution.

What is the Formula of Solubility Product?

Answer:

This equation suggests that the product of the equilibrium concentrations of the Ag^+ and Cl^- ions in this solution is equal to a constant. Since this constant is proportional to the solubility of the salt, it is called the solubility product equilibrium constant for the reaction, or K_{sp} .

What is Solubility Product of Water?

Answer:

Solubility product, K_{sp} , applies in situations where salts do not fully dissolve in a solvent. The solvent is generally water. A substance's solubility product is the mathematical

product of its dissolved ion concentrations raised to the power of their stoichiometric coefficients.

What is Solubility Product?

Answer:

The solubility product is a kind of equilibrium constant and its value depends on temperature. K_{sp} usually increases with an increase in temperature due to increased solubility. Solubility is defined as a property of a substance called solute to get dissolved in a solvent in order to form a solution.

What is Solubility Product and Its Application?

Answer:

The important applications of Solubility product are Salting out of soap. Soap is sodium salt of higher fatty acid. It is precipitated from the solution by adding concentrated solution of NaCl (sodium chloride) . Hence soap precipitates out from the solution.

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